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(54) Method for production of a contact piece for a switchgear assembly, as well as a contact piece itself

(57) The invention relates to a method for production of a contact piece for a switchgear assembly, and to a contact piece itself, as claimed in the preamble of patent claims 1 and 15. In order in this case to introduce the slot and to apply a contact outer contour directly during the powder-metallurgical production process of the contact material, the invention proposes that contouring, in particular via a thin plastic film, in the form of a slot or slots is introduced into the component and/or into the contact piece and/or into the powder-metal material, which is located in a mold, essentially in a direction parallel to the normal to the surface of the component or contact piece.

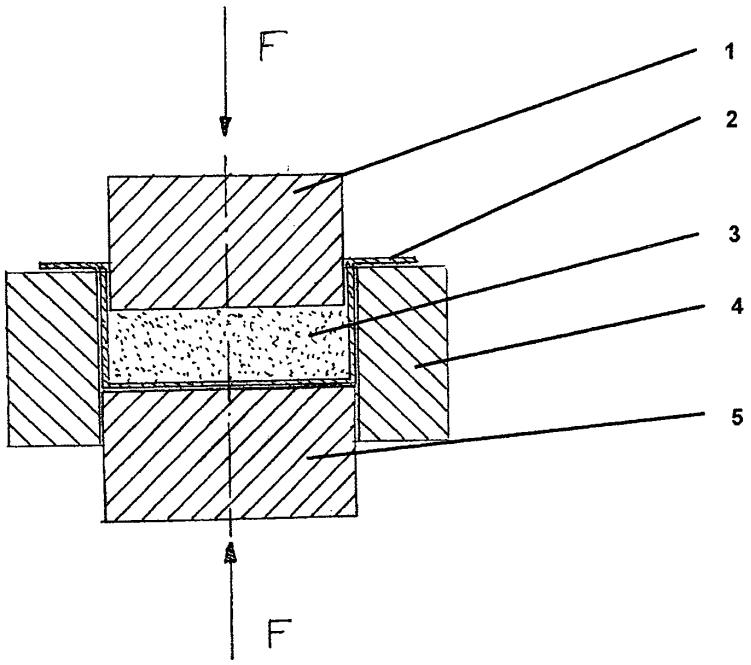

Figure 1

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Description

[0001] The invention relates to a method for production of a contact piece for a switchgear assembly, and to a contact piece itself, as claimed in the preamble of patent claims 1 and 15.

[0002] Said contact pieces relate essentially to low-voltage, medium-voltage and high-voltage switching devices, as well as generator switching devices, which are equipped with vacuum interrupter chambers. The vacuum interrupter chambers are frequently equipped with a so-called radial magnetic field (RMF) contact system. The radial magnetic field is generated by means of sickle-shaped coil segments. The sickle-shaped elements are produced by slots which are introduced into a contact piece plate. It is also possible to use a slotted contact pot which generates the radial magnetic field on an annular surface.

[0003] However, slots are likewise required and are introduced in a contact piece plate. Furthermore, slots are generally also required in a contact plate when using AMF contact systems. Furthermore, this method as described below can be used to produce components for widely different applications by powder metallurgy, in particular when the aim is to press abrasive powders without the use of lubricants.

[0004] One major advantage of the RMF contact systems that have been mentioned is the low current-path resistance of the overall arrangement using a contact pressure force.

[0005] RMF contact pieces in the shape of cylindrical disks are normally used, whose outer edges are rounded in order to improve the dielectric characteristics. Metal-cutting methods are used to apply the outer contour and to introduce the slots. The external geometry is accordingly applied by means of a turning operation, and the slots are introduced into the contact piece by sawing or milling. In the case of contact plates which are comparatively thin, it is also possible to use stamping methods, see the application cited below. Once the slots have been introduced, the slot edges can be rounded, reworked or deburred manually or by machine in order to increase the dielectric strength of the mutually opposite contact pieces.

[0006] In order to further optimize the contact production method, a method is proposed on the basis of which both the external geometry and the slot geometry are incorporated in a blank directly during the production of the contact piece. In this case, slots aligned at right angles to the surface can be introduced as well as slots which are intended to be oriented at an angle to the surface. Furthermore, it is possible for the slots to extend as far as the external circumference of a disk, and to end within it.

[0007] If a contact piece is intended to be composed of two layers (CuCr powder layer and Cu powder layer), these can likewise be pressed with one another, using this method. The erosion-resistant layer may be composed of the standard contact material CuCr 25, which is predominantly used for medium voltages, and the second layer can preferably be composed of pure copper for high conductivity in this layer. Further layers are likewise feasible.

[0008] Use of multilayer contact blanks and contact pieces is known from the prior art.

[0009] Furthermore, this method can be used in engineering for a multiplicity of applications for pressing of powders, in this case particularly in the case of abrasive powders. This opens up a wide field for the powder-metallurgical P/M production of components without the use of lubricants, which are generally added to the powders to be pressed. These lubricants are added to the powder materials with a proportion by weight of about 1% in order to considerably lengthen the tool life. The disadvantage is that these lubricants must be forced out of the finally pressed component (the blank).

[0010] For example, DE 3840192 C2 discloses a switching contact arrangement for electrical vacuum switches, whose slotted contact pieces are formed from a plurality of disks placed one on top of the other. In this case, the individual disks are slotted by stamping.

[0011] Furthermore, US 6010659 and EP 1111631 disclose a method for production of a multilayer contact (MLC) which comprises a plurality of layers. This also describes the capability to produce a contact from the two layers CuCr and copper, for example in a ceramic crucible using the sintering-melting method.

[0012] Furthermore, DE 19717024 A1 discloses a method for production of a contact piece provided with slots for a vacuum interrupter chamber, and a shaping tool for carrying out the method. In this case, the slot edges are shaped and are rounded by means of a pressing process, using a pressing tool.

[0013] The present methods for introduction of the slots are accordingly also metal-cutting methods.

[0014] The generation of the contact piece geometry by the cutting technique is, of course, associated with corresponding costs. Manual deburring or deburring by means of a tool requires an additional process for deburring or rounding of the slot edges.

[0015] The invention is therefore based on the object of introducing the slot and/or of applying a contact external contact directly during the powder-metallurgical production process of the contact material.

[0016] According to the invention, in the case of a method of this generic type, the object is achieved by the characterizing features of claim 1.

[0017] Further advantageous refinements are specified in the dependent claims 2 to 14.

[0018] According to the invention, with regard to a component, the stated object is achieved by the characterizing features of claim 15.

[0019] Further advantageous refinements are specified in the other dependent claims.

[0020] The essence of the invention relating to the method is therefore that contouring in the form of a slot

or slots is introduced into the component and/or into the contact piece and/or into the powder-metal material, which is located in a mold, essentially in a direction parallel to the normal to the surface of the component or contact piece.

[0021] In other words, this means that the slots are pressed into the powder mixture from above by means of a tool.

[0022] This is considerably simpler than any other way of introducing slots.

[0023] A further advantageous refinement provides that the contouring in the form of a slot or slots is introduced into the powder mixture via a film which is arranged between the tool and the powder metal.

[0024] In this case, the film may be in two alternative forms, either a thin plastic film or a thin metal film.

[0025] In one advantageous refinement, the film has a thickness of 0.001 mm to 2 mm.

[0026] It is particularly advantageous in one refinement of the method for the film to be fitted into the mold on the powder metal filling by direct extrusion in a separate method step before the slots are pressed in.

[0027] The powder mixture may advantageously be a mixture of copper and chromium.

[0028] It is likewise advantageous for the component, particularly in the case of a contact piece, to be in the form of a multilayer contact piece.

[0029] The proportion of chromium may advantageously be between 0 and 100 per cent by weight.

[0030] It is simple and therefore advantageous to use powder which has already been alloyed in the production process.

[0031] In this case, particle sizes of 0 to 150 micrometers are advantageous for the granulate, that is to say the powder.

[0032] In order to achieve the final dimensions without any metal-cutting step, it is advantageous that after the pressing process and/or after the heat-treatment of the blank, a final calibration pressing process is carried out accurately for the final dimensions.

[0033] Particularly for use in vacuum interrupter chambers, it is advantageous for the component or contact piece to be chemically heat treated in a hydrogen atmosphere, and/or to be degassed by heat treatment in a vacuum.

[0034] These measures also make it possible to partially or entirely avoid the costs for generation of the contact piece geometry. A further cost saving is achieved by reducing the amount of powder material required, by avoiding the material volume of the slots, as well as the excess dimensions which may normally be required (of the finished component for machining). If no lubricants are added to the powder material to be pressed, then, particularly in the case of abrasive powders or else powder mixtures, there is a risk of the pressing tool life being reduced. When using this method, there is no need to add lubricants to the powder material.

[0035] A ready-for-installation contact piece can be produced by choosing a powder-metallurgical production process in the following manner:

1. Pressing related to the production of CuCr contact pieces:

[0036] After mixing the powders copper and chromium, the powder mixture is inserted in a mold which is provided completely or else only partially with a plastic or metal film. In addition to the upper die and lower die that are required, these also contain the web, for example of a die side. It may be necessary for the webs likewise to be arranged such that they can move, for example in the die. The two dies must for their part be designed such that the external geometry is applied at the same time as the pressing of the powder mixture together with the slots on to the resultant blank. In this case, the powder or in this case the powder mixture is located in a thin-walled film (bag), in particular in that surface area where the high pressures occur.

[0037] Once the blank has been removed from the mold, this results in a blank whose dimensions are close to the dimensions of the drawing, that is to say the final dimensions, but which are provided with the necessary sintering supplement (shrinkage supplement) before the sintering of the material, and the film that is present must be removed from the tool and from the pressed item before the following cycle is started. The design of the tool and the number of trials can be shortened by the use of appropriate calculation software for sintering allowing prediction of the majority of the possible distortion, or of the distortion which may occur, for example during the subsequent sintering process, in advance (for example density differences which remain in the blank during pressing, sintering activity ...).

2. Sintering:

[0038] As normal, the sintering of the blank contact pieces can be carried out in a vacuum or in hydrogen, without any lubricant having been used for the production of a blank. However, for the production of a ready-to-use contact piece, a reducing atmosphere can/should be present at least temporarily (heat treatment). A vacuum heat treatment may possibly subsequently be advantageous after this reducing process step, in order to reduce the hydrogen gas content in the material.

3. Calibration pressing:

[0039] If distortion of the ready-to-use contact piece nevertheless occurs during the sintering process, or the specified final dimensions cannot be achieved, then the contact piece can be calibrated in a further pressing method and can thus be brought to the final dimensions, and/or any external radii, inclines, steps etc. that are still required can be applied.

[0040] The invention will be described in more detail

in the following text and is illustrated in the drawing, in which:

Figure 1: shows a pressing tool and a plastic film inserted in it

Figure 2: shows a plastic film with an open base, and

Figure 3: shows inserts in the pressing mold.

[0041] Figure 1 shows a pressing tool with a plastic film (2) inserted in it. The tool is equipped with a molding film over the entire surface area or only over part of the area. Within the film bag (2) (bag closed on one side in some areas or else effective only in the edge area). The upper die (1) presses against the lower die (5), with the powder (3) to be pressed located between them. The radially occurring forces are absorbed by the mold (4).

[0042] Figure 2 shows a pressing tool with a plastic film (2) inserted in it, which acts only in part of the area, and the base (6) is not present. The upper die (1) presses against the lower die (5) with the powder (3) to be pressed being located between them. The radially occurring forces are absorbed by the mold (4).

[0043] Figure 3 shows a pressing tool with a plastic film (2) inserted in it, whose shape is more complex in some areas. The tool is equipped with a molding film over the entire surface area, or over only part of the area. Within the film bag (2) (bag closed on one side in some areas or else effective only in the edge area). The upper die (1) presses against the lower die (6) with the powder (4) to be pressed being located between them. More complex pressing shapes can be generated in this case (7) by means of appropriate inserts, and the film may be present (3) in part of the area, or else can be produced without a base. The radially occurring forces are absorbed by the mold (5).

List of reference symbols

[0044]

1 Upper die
2 Film
3 Subarea, open base
4 Metallurgical powder
5 Lower die
6 Mold
7 Inserts

Claims

1. A method for powder-metallurgical production of a component, in particular of a contact piece for low-voltage, medium-voltage, high-voltage and generator switching devices,
wherein
contouring in the form of a slot or slots is introduced into the component and/or into the contact piece and/or into the powder-metal material, which is located in a mold, essentially in a direction parallel to the normal to the surface of the component or contact piece.

2. The method as claimed in claim 1,
wherein
the contouring in the form of a slot or slots is introduced into the powder mixture via a film which is arranged between the tool and the powder metal.

3. The method as claimed in claim 2,
wherein
the film is a thin plastic film.

4. The method as claimed in claim 3,
wherein
the plastic is a permanent contact or fixed contact.

5. The method as claimed in claim 2,
wherein
the film is a thin metal film.

6. The method as claimed in claim 3, 4 or 5,
wherein
the film has a thickness of 0.001 mm to 2 mm.

7. The method as claimed in one of the preceding claims,
wherein
the film is fitted into the mold on the powder metal filling by direct extrusion in a separate method step before the slots are pressed in.

8. The method as claimed in one of the preceding claims,
wherein
the powder mixture is a mixture of copper and chromium.

9. The method as claimed in one of the preceding claims,
wherein
the contact piece is in the form of a multilayer contact piece.

10. The method as claimed in one of the preceding claims,
wherein
the proportion of chromium is between 0 and 100 per cent by weight.

11. The method as claimed in one of the preceding claims,
wherein
the powder is powder that has already been alloyed.

12. The method as claimed in one of the preceding claims,
wherein
the powder is in the form of a granulate with a particle size from 0 to 150 micrometers.

13. The method as claimed in one of the preceding claims,
wherein,
after the pressing process and/or after the heat-treatment of the blank, a final calibration pressing process is carried out accurately for the final dimensions.

14. The method as claimed in one of the preceding claims,
wherein
the component or contact piece is chemically heat treated in a hydrogen atmosphere, and/or is degassed by heat treatment in a vacuum.

15. A component produced using a method as claimed in one or more of the preceding claims 1 to 14.

16. The component as claimed in claim 15,
wherein
the component is a contact piece for low-voltage, medium-voltage, high-voltage or generator switching devices.

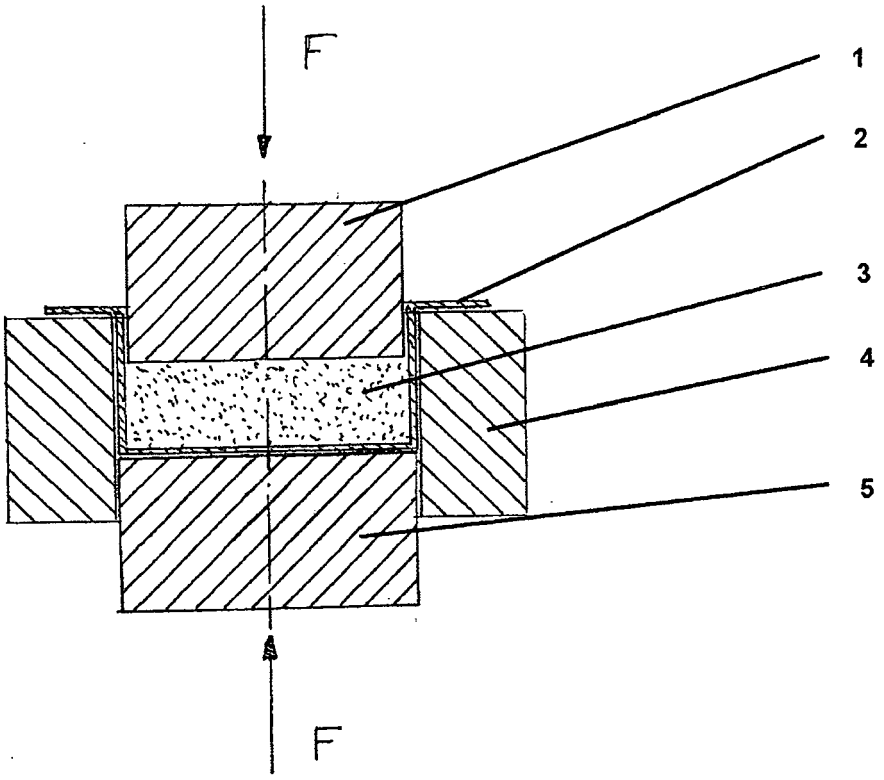

Figure 1

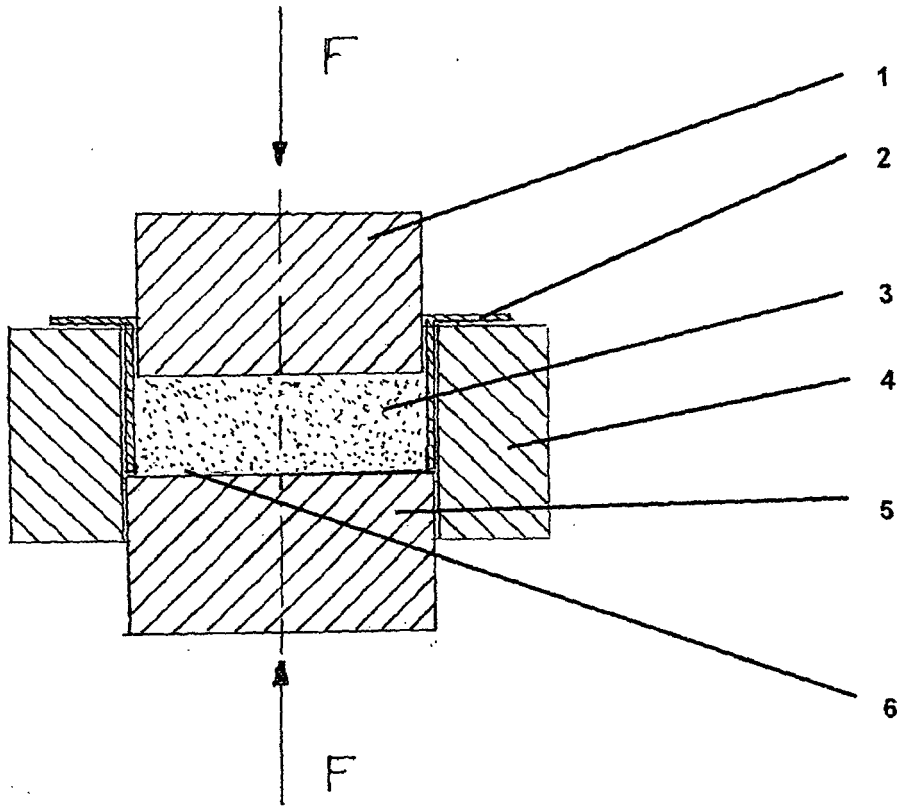

Figure 2

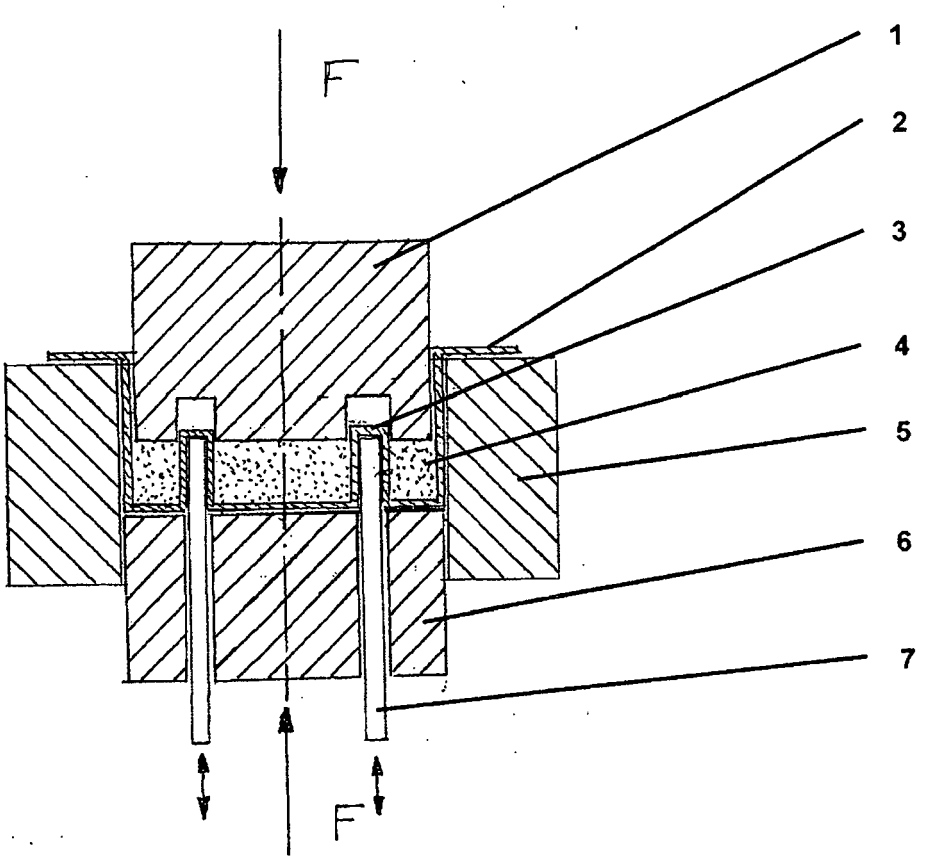

Figure 3

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EUROPEAN SEARCH REPORT

Application Number
EP 07 01 0889

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2006/111175 A (ABB TECHNOLOGY AG [CH]; GENTSCH DIETMAR [DE]) 26 October 2006 (2006-10-26) * claims * -----	1-16	INV. B22F3/02 H01H11/04

TECHNICAL FIELDS SEARCHED (IPC)

B22F
H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 November 2007	ALVAZZI DELFRATE, M

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2006111175 A	26-10-2006	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 3840192 C2 **[0010]**
- US 6010659 A **[0011]**
- EP 1111631 A **[0011]**
- DE 19717024 A1 **[0012]**